



Data Paper

Harvestmen occurrence database (Arachnida, Opiliones) of the Museu Paraense Emílio Goeldi, Brazil

Valéria J. da Silva[‡], Manoel B. Aguiar-Neto[‡], Dan J. S. T. Teixeira[‡], Cleverson R. M. Santos[‡], Marcos Paulo Alves de Sousa[‡], Timoteo M. da Silva[‡], Lorrán A. R. Ramos[‡], Alexandre Bragio Bonaldo[§]

[‡] Museu Paraense Emílio Goeldi, Belém, Brazil

[§] Laboratório de Aracnologia, Museu Paraense Emílio Goeldi, C.P. 399, 66017-970 Belém, Pará, Brazil, Belém, Brazil

Corresponding author: Marcos Paulo Alves de Sousa (msousa@museu-goeldi.br),

Alexandre Bragio Bonaldo (bonaldo@museu-goeldi.br)

Academic editor: Adriano Kury

Received: 19 Oct 2019 | Accepted: 20 Dec 2019 | Published: 31 Dec 2019

Citation: da Silva VJ, Aguiar-Neto MB, Teixeira DJST, Santos CRM, de Sousa MPA, da Silva TM, Ramos LAR, Bragio Bonaldo A (2019) Harvestmen occurrence database (Arachnida, Opiliones) of the Museu Paraense Emílio Goeldi, Brazil. Biodiversity Data Journal 7: e47456. <https://doi.org/10.3897/BDJ.7.e47456>

Abstract

Background

We present a dataset with information from the Opiliones collection of the Museu Paraense Emílio Goeldi, Northern Brazil. This collection currently has 6,400 specimens distributed in 13 families, 30 genera and 32 species and holotypes of four species: *Imeri ajuba* Coronato-Ribeiro, Pinto-da-Rocha & Rheims, 2013, *Phareicranaus patauateua* Pinto-da-Rocha & Bonaldo, 2011, *Protimesius trocaraincola* Pinto-da-Rocha, 1997 and *Sickesia tremembe* Pinto-da-Rocha & Carvalho, 2009. The material of the collection is exclusive from Brazil, mostly from the Amazon Region. The dataset is now available for public consultation on the Sistema de Informação sobre a Biodiversidade Brasileira (SiBBR) (<https://ipt.sibbr.gov.br/goeldi/resource?r=museuparaenseemiliogoeldi-collection-aracnologiaopiliones>). SiBBR is the Brazilian Biodiversity Information System, an initiative of the government and the Brazilian node of the Global Biodiversity Information Facility (GBIF),

which aims to consolidate and make primary biodiversity data available on a platform (Dias et al. 2017).

New information

Harvestmen or Opiliones constitute the third largest arachnid order, with approximately 6,500 described species. Brazil is the holder of the greatest diversity in the world, with more than 1,000 described species, 95% (960 species) of which are endemic to the country. Of these, 32 species were identified and deposited in the collection of the Museu Paraense Emílio Goeldi.

Keywords

Amazon, arachnology, database, Opiliones, occurrence

Introduction

The Museu Paraense Emílio Goeldi (MPEG) is the second oldest, with a preserved collection, institution of research and natural history of Brazil and the oldest zoo of the country (Sanjad et al. 2012). MPEG was founded in 1866 and presently possesses several biological collections harbouring extensive taxonomic, geographic and ecological representation, which has accumulated biological and cultural information since the 19th century. Currently, MPEG is a federal research institution within the Brazilian Ministry of Science, Technology and Communication (MCTIC) that holds more than 4 million biological and cultural items, distributed in four administrative branches: Coordination of Human Sciences (COCH), Coordination of Earth Sciences and Ecology (COCTE), Coordination of Botany (COBOT) and Coordination of Zoology (COZOO). The COZOO is responsible for maintaining large collections, such as Ichthyology (), Herpetology (da Costa Prudente et al. 2019), Ornithology, Mastozoology, Carcinology, Entomology and Arachnology, as well as other collections of non-arthropod invertebrates.

One of the largest collections of invertebrates of MPEG is the collection of Arachnology and its subcollections, amongst which are the Opiliones collection, which receive and preserve material evidence on the taxonomic, biogeographic and ecological diversity of these organisms, including specimens and associated data and metadata collected in the field, for research and educational purposes.

Harvestmen or Opiliones constitute the third largest arachnid order (Kury and Pinto-da-Rocha 2002), with approximately 6,500 described species (Kury 2019), Brazil being the holder of the greatest diversity in the world, with more than 1,000 described species, 95% (960 species) of which are endemic to the country, a situation that, according to Kury (2019), can be explained by the combination of natural diversity and concentration of studies.

Despite the fact that the MPEG invertebrate collections are nearly as old as the institution itself, the Opiliones collection (Fig. 1) is fairly recent and started to be organised and received special attention only after the establishment of an active line of research in arachnology, back in 2000. However, the first specimens were collected in the 1960s, representing incidental sampling efforts. Currently, the Arachnological collection comprises a large collection from the Amazon Region with nearly 40,000 vials of arachnids. The collection is supported by two permanent researchers, also by a team of associated researchers and a variable number of undergraduate students from several universities and graduate students from two Postgraduate Programmes held by the Museum: Postgraduate in Zoology - PPGZOO (Federal University of Pará/MPEG) and Biodiversity and Evolution - PPGBE (MPEG).



Figure 1. [doi](#)

A, B General view of the Opiliones collection of the Museu Paraense Emílio Goeldi, Belém, Pará, Brazil.

The North, Northwest and central areas of Brazil are not as well sampled regarding harvestmen as the South and Southwest portions of the country (Pinto-da-Rocha 1999). Although some efforts have been made in the last 20 years, the sampling of this taxonomic group in these regions is still insufficient (Tourinho et al. 2019). The data, shared through GBIF and presented in this paper represent a contribution to the knowledge, especially from 2000 to 2009, mainly of amazon harvestmen and also a divulgation of the potential of research in this area. In those data, there are information of the most complete inventory for Opiliones in Amazon lands made in the national forest of Caxiuanã, in Melgaço, Pará (Lança 2011), where a structured protocol was utilised to inventory arachnids in this area (Bonaldo et al. 2009).

Coari, in the state of Amazonas, where the largest number of specimens of the collection were collected, is an important city for the investigation of development in Amazon, anthropic impacts and energy producing and where a large number of studies have been made in diverse areas of knowledge (Soler 2009, Feitosa et al. 2017). That municipality harbours the largest proven terrestrial oil and natural gas reserve (Petrobras 2016), that

has oil explorations and a gas pipeline through middle Amazon. As a consequence, the deforestation in Coari has triplicated between 1985 and 2003 and the transformation of soil in that same period by anthropisation and deforestation, represents 500 km² (Almeida and Souza 2008). Sampling and describing occurrence and natural history Opiliones are important as tools to measure loss of biodiversity over time, especially because they have the potential as biological controllers and also bio-indicators of environmental quality, given their sensitivity to environmental changes, dependency on microclimatic conditions and low vagility (Bragagnolo et al. 2007, Merino and Prieto 2015). Opiliones, in general, present high levels of endemism and, consequently, high risk of extinction when major areas are devastated (Machado et al. 2008)

The objective of this datapaper is to characterise the MPEG Harvestmen collection data, synthesising data to serve as reference and a font of accessible information from part of the Brazilian biodiversity. Data is published through SiBBR: <https://ipt.sibbr.gov.br/goeldi/resource?r=museuparaenseemiliogoeldi-collection-aracnologiaopiliones>.

Sampling methods

Sampling description: The specimens are preserved in fluid (alcohol 80%). The Opiliones collection of MPEG has received collections from many scientists who used various sampling methods. Sampling methods included pitfall traps, entomological beating trail, Malaise trap, Winkler apparatus, Swiping net, fogging, sieve, manual collection, as well as incidental encounters (see Pinto-da-Rocha and Bonaldo 2006, Bonaldo et al. 2009).

Quality control: The taxonomic organisation of the collection followed the Classification of Opiliones provided by Kury (2019). The material was identified by comparison with the bibliography and material present in the collections, which were previously identified by specialists. Determination of specimens of collections was mostly made by three specialists: Lo-Man-Hung, N.F., Pinto-da-Rocha, R. and Tourinho, A.L. with 1,394, 361 and 40 specimens identified, respectively.

Geographic coverage

Description: The collection includes specimens only from Brazil. Most samples come from the Amazon Region, from the following states: Pará (n = 1,378 vials), Amazonas (n = 1,338 vials), Rondônia (n = 13 vials) and Amapá (n = 4 vials). Other Brazilian States represented in the collection include: Piauí (n = 10 vials), Mato Grosso (n = 3 vials), Ceará (n = 2 vials) and Pernambuco (n = 1 vial). Most specimens were captured in Base de Operações Geólogo Pedro de Moura, Porto Urucu, Coari, Amazonas and in the Floresta Nacional de Caxiuanã, Melgaço and Portel, Pará (Fig. 2).

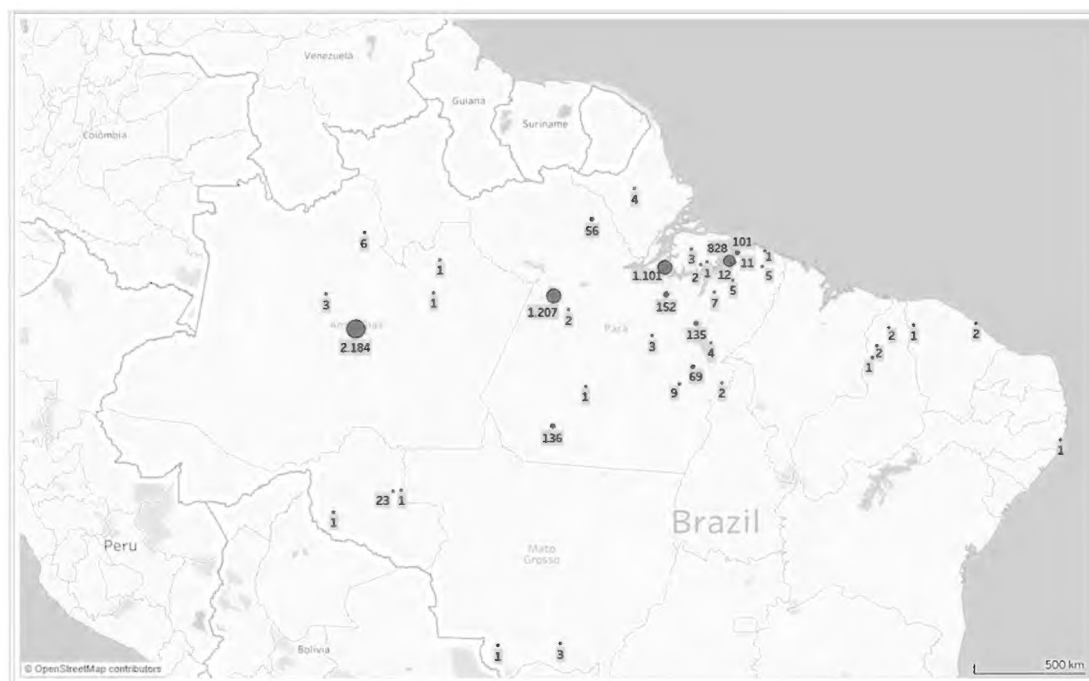


Figure 2. [doi](#)

Map of occurrence records, MPEG Opiliones collection (each point may represent more than one sampling event).

In relation to the richness of species for each state, Pará has the highest number of species ($n = 20$) recorded in the collection, while Amazonas has 13 species, Amapá, Rondônia, Piauí and Mato Grosso each have one species. The species *Saramacia lucasae* Jim & Soares, 1991 (Jim and Soares 1991) presents the greatest geographical representation in the collection, being registered in the collection in the states Amapá, Amazonas and Pará.

Coordinates: and Latitude; and Longitude.

Taxonomic coverage

Description: The MPEG Opiliones collection includes approximately 6,400 specimens, distributed in 2,789 vials, represented by two suborders (Eupnoi and Laniatores), 13 families, 30 genera and 32 species. However, the number of species may be increased by adding the taxonomic information of material currently identified only at supraspecific levels (approximately 3,400 specimens). The most common suborder is Laniatores with 2,369 vials. Amongst these, there are 39 type specimens, of which four are holotypes and 35 are paratypes. All type specimens, included in the collection, are detailed below.

List of species with holotype and paratype in the collection:

Imeri ajuba Coronato-Ribeiro, Pinto-da-Rocha & Rheims, 2013 (Coronato-Ribeiro et al. 2013), *Phareicranaus patauateua* Pinto-da-Rocha & Bonaldo, 2011 (Pinto-da-Rocha and Bonaldo 2011, see Fig. 3), *Protimesius trocaraincola* Pinto-da-Rocha, 1997 (Pinto-da-Rocha 1997) and *Sickesia tremembe* Pinto-da-Rocha & Carvalho, 2009 (Pinto-da-Rocha and Carvalho 2009).



Figure 3. [doi](#)

Male holotype holotype of *Phareicranaus patauateua*. Scale bars = 2 mm.

List of species with only paratype in the collection:

Stygnus kuryi Pinto-da-Rocha & Tourinho, 2012, *Stygnus nogueirai* Pinto-da-Rocha & Tourinho, 2012 and *Stygnoplus tapirapeco* Pinto-da-Rocha & Tourinho, 2012 (Pinto-da-Rocha and Tourinho 2012).

Taxonomic ranks:

Kingdom: Animalia

Phylum: Arthropoda

Class: Arachnida

Order: Opiliones

Family: Agoristenidae, Biantidae, Cosmetidae, Cranaidae, Fissiphalliidae, Gonyleptidae, Kimulidae, Manosbiidae, Samoidae, Sclerosomatidae, Stygnidae, Stygnommatidae, Zalmoxidae Fig. 4

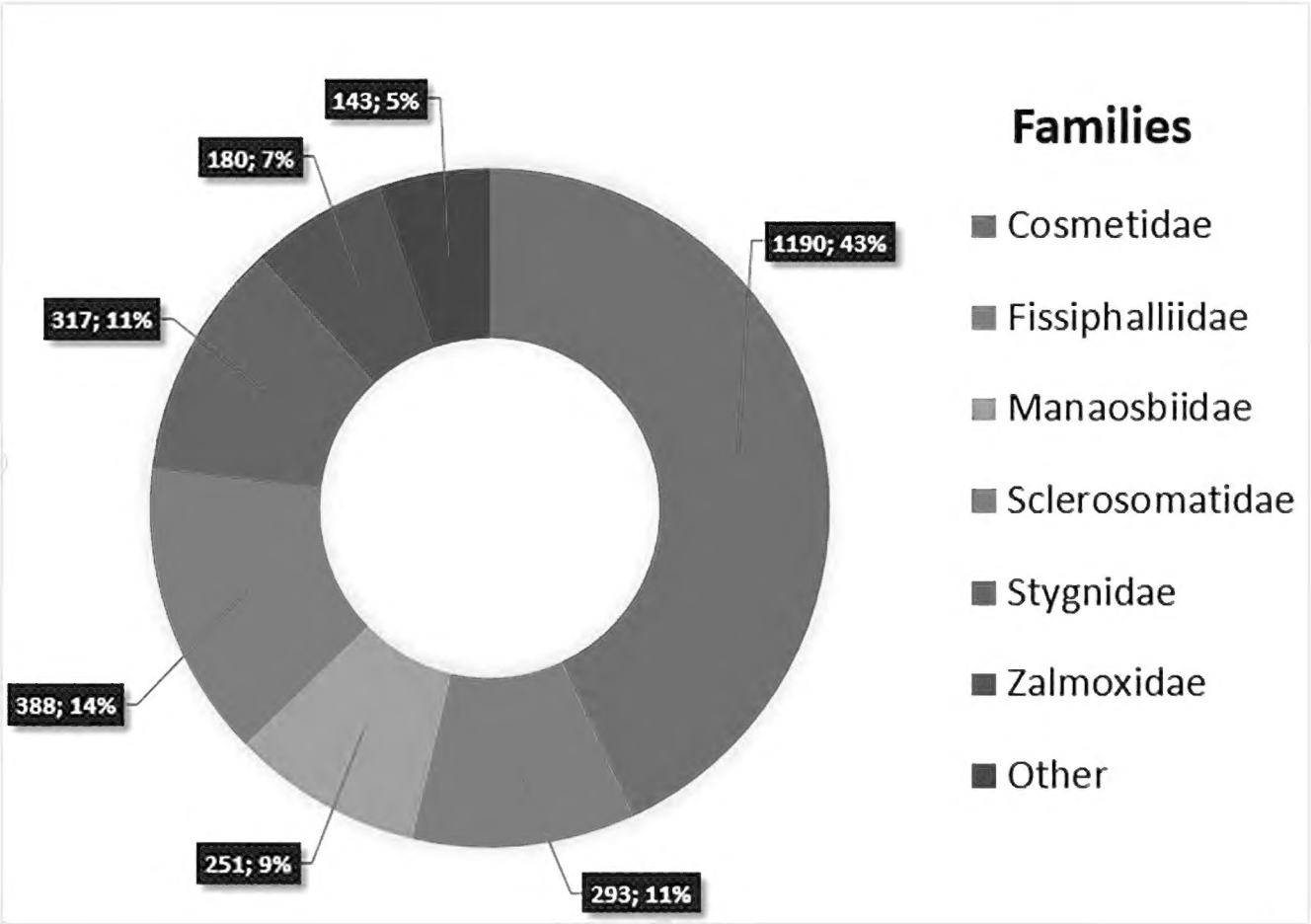


Figure 4. [doi](#)
Distribution of families in the Collection of Opiliones, MPEG. Number of vials and frequencies are represented for each family.

Taxa included:

Rank	Scientific Name
kingdom	Animalia
phylum	Arthropoda
class	Arachnida
order	Opiliones
family	Agoristenidae
family	Biantidae
family	Cosmetidae
family	Cranaidae
family	Fissiphalliidae
family	Gonyleptidae
family	Kimulidae
family	Manaosbiidae
family	Samoidae

family	Sclerosomatidae
family	Stygnidae
family	Stygnommatidae
family	Zalmoxidae

Temporal coverage

Formation period: 1965-2009.

Notes: Specimens in the collection date from 1965 to 2009 (Fig. 5). The data show the quantity of curated vials by year, depicting three significant increments, one during 1984, later in 2002–2003, with more than 700 vials and the most recent period in collection is observed in 2006–2007, with more than 1,300 vials. These increments coincide with the implementation of major institutional projects at MPEG, which represented field trip opportunities to Carajás National Forest, Pará, Urucu River, Amazonas and Juruti, Pará. Amongst the vials listed, there are 205 (7%) without the date information.

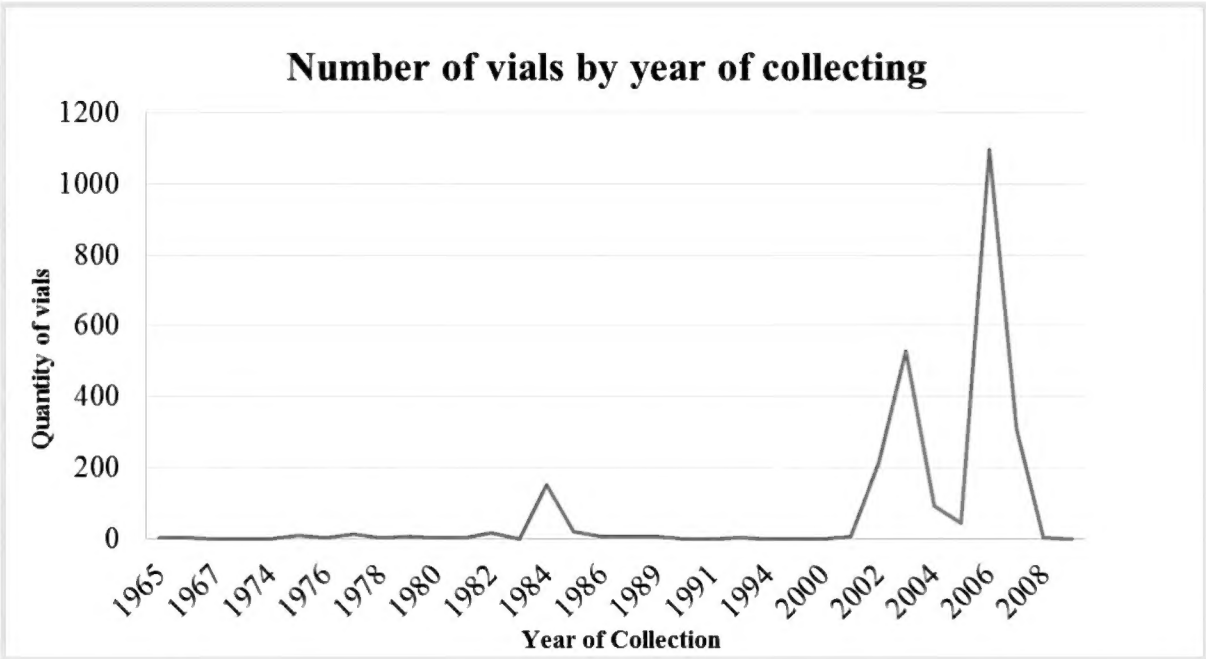


Figure 5. [doi](#)
Distribution of number of curated vials by collection year.

Collection data

Collection name: Opiliones

Collection identifier: MPEG.OPI

Parent collection identifier: Museu Paraense Emílio Goeldi

Specimen preservation method: Ethanol 80%

Usage rights

Use license: Other

IP rights notes: Creative Commons Attribution Non-Commercial (CC-BY-NC) 4.0 License

Data resources

Data package title: Museu Paraense Emílio Goeldi – Opiliones Collection

Resource link: <https://www.gbif.org/dataset/4140cabb-6d7d-4155-8a00-9dfb0bfde61d>

Alternative identifiers: <https://ipt.sibbr.gov.br/goeldi/resource?r=museuparaenseemiliogoeldi-collection-aracnologiaopiliones&v=6.2>

Number of data sets: 1

Data set name: Museu Paraense Emílio Goeldi - Opiliones Collection

Download URL: <https://ipt.sibbr.gov.br/goeldi/resource?r=museuparaenseemiliogoeldi-collection-aracnologiaopiliones>

Data format: Darwin Core Archive (DwC-A)

Data format version: 11.2

Description: This collection currently has 6,400 specimens distributed in 13 families, 30 genera and 32 species. The full database is available via the Integrated Publishing Toolkit (IPT) of Museu Paraense Emílio Goeldi (version 6.1 published in 2018-07-26)

Column label	Column description
occurrenceID	An identifier for the Occurrence
dcterms:modified	The most recent date-time on which the resource was changed
dcterms:licence	A legal document giving official permission to do something with the resource
dcterms:rightsHolder	A person or organisation owning or managing rights over the resource
institutionCode	The name (or acronym) in use by the institution having custody of the object(s) or information referred to in the record
datasetName	The name identifying the dataset from which the record was derived
basisOfRecord	The specific nature of the data record - a subtype of the dcterms:type
catalogNumber	An identifier for the record within the dataset or collection
recordedBy	A list of names of people, groups or organisations responsible for recording the original Occurrence
preparations	A list of preparations and preservation methods for a specimen

otherCatalogNumbers	A list of previous or alternate fully qualified catalogue numbers or other human-used identifiers for the same Occurrence
EventDate	The date-time or interval during which an Event occurred
higherGeography	A list of geographic names less specific than the information captured in the locality term
continent	The name of the continent in which the Location occurs
country	The name of the country or major administrative unit in which the Location occurs
stateProvince	The name of the next smaller administrative region than country
county	The full, unabbreviated name of the next smaller administrative region than stateProvince
typeStatus	A list of nomenclatural types
scientificName	The full scientific name
kingdom	The full scientific name of the kingdom in which the taxon is classified
phylum	The full scientific name of the phylum or division in which the taxon is classified
class	The full scientific name of the class in which the taxon is classified
order	The full scientific name of the order in which the taxon is classified
family	The full scientific name of the family in which the taxon is classified
genus	The full scientific name of the genus in which the taxon is classified
specificEpithet	The name of the first or species epithet of the scientificName
infraspecificEpithet	The name of the lowest or terminal infraspecific epithet of the scientificName, excluding any rank designation
collectionCode	The name, acronym, coden or initialism identifying the collection or dataset from which the record was derived

Additional information

Data publication protocol

To the publication of the data of the Opiliones collection, we used a consolidated protocol of data publication of the Goeldi Museum, previously adopted in collections of Ichthyology (Silva et al. 2017) and of snakes (da Costa Prudente et al. 2019).

- **Pre-digitisation phase:** The preservation status of harvestmen specimens was reviewed prior to digitisation. An effort was also made to identify specimens and review previous identifications.
- **Digitalisation phase:** All biodiversity data available on the specimens' labels (i.e. voucher specimens, taxa identification and name of determiner, sex, number of specimens in the vial, locality, date, habitat, collector, collection method, research project and observations etc.) were digitised in a Microsoft Excel spreadsheet

adopting the Specify format (Specify 2019). The spreadsheet data were then imported into the Specify database, but the Workbench tool performs a data check for duplicity, consistency and standardisation errors (i.e. geographic coordinates, date etc.). The data were imported only after this check.

- **Creation of the dataset:** The dataset was exported from Specify software to the DarwinCore Archive format v1.4 (Wieczorek et al. 2012), with metadata to ensure rapid discovery of this biodiversity resource and future publishing as a citable paper (Chavan and Penev 2011). The collection dataset was uploaded to the Integrated Publishing Toolkit (IPT), which was then submitted and published at Sistema de Informação sobre a Biodiversidade Brasileira (SiBBr - <https://www.sibbr.gov.br>). A second kind of data exportation is to upload data into the MPEG biodiversity portal (<http://colecoesbio.museu-goeldi.br/opiliones.html>). Information of records, images – when available - and maps could be consulted according to the need (Fig. 6). This structure is based in SPECIFY web portal architecture.

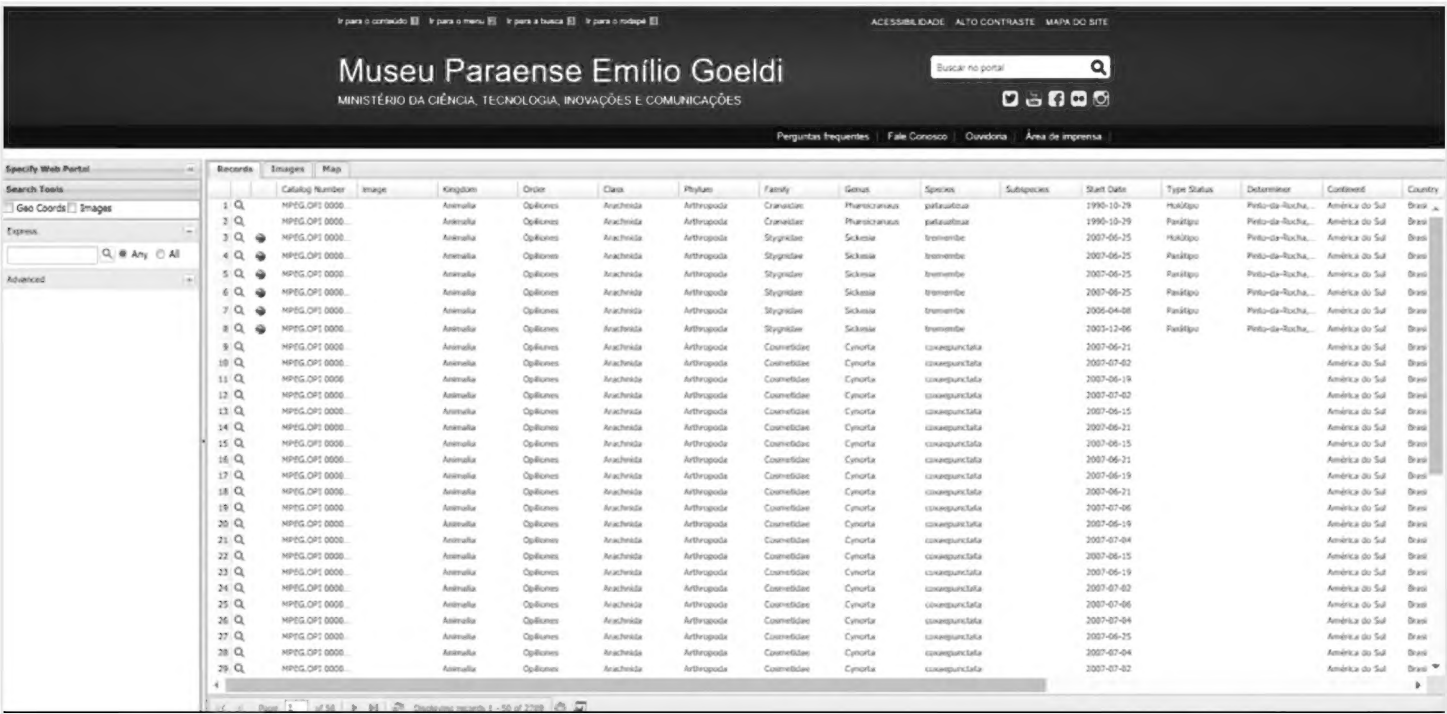


Figure 6. [doi](#)
Museu Paraense Emílio Goeldi web portal of Opiliones Collection.

Curatorship and storage

The curatorial protocol involves receiving material that is identified and labelled, while data and metadata are digitised. The materials are deposited in the collection and air-conditioned to 22°C. The specimens are immersed in 80% alcohol solution for permanent storage.

Acknowledgements

The authors would like to thank MPEG Biogeo-Informatics Department who helped processing the data. We thank the Programa de Capacitação Institucional (MPEG/MCTIC) and Conselho Nacional de Desenvolvimento Científico e Tecnológico, CNPq (grant number

300124/2018-0 to VJS; 300836/2018-0 to DJST; PQ grant 304965/2012-0 to ABB) and CRMS thanks Sistema de Informação sobre a Biodiversidade Brasileira (SiBBR) for the financial support (CNPq project numbers 401901/2014-9; 442021/2016-0) and to Financiadora de Estudos e Projetos (FINEP. Project number 1343/13).

References

- Almeida WSd, Souza NMd (2008) Coari: Petróleo e Sustentabilidade – um exemplo amazônico. *Desenvolvimento e Meio Ambiente* 17: 69-92. <https://doi.org/10.5380/dma.v17i0.13413>
- Bonaldo AB, Carvalho LS, Pinto-da-Rocha R, Tourinho A, Miglio LT, Candiani DF, Lo-Man-Hung NF, Abraham N, Rodrigues BV, Brescovit AD, Saturnino RF, Bastos NC, Dias SC, Silva BJ, Pereira-Filho JM, Rheims CA, Lucas SM, Polotow D, Ruiz GR, Indicatti RP (2009) Inventário e história natural dos aracnídeos. Belém: Museu Paraense Emílio Goeldi 577-621.
- Bragagnolo C, Nogueira A, Pinto-da-Rocha R, Pardini R (2007) Harvestmen in an Atlantic forest fragmented landscape: Evaluating assemblage response to habitat quality and quantity. *Biological Conservation* 139: 389-400. <https://doi.org/10.1016/j.biocon.2007.07.008>
- Chavan V, Penev L (2011) The data paper: a mechanism to incentivize data publishing in biodiversity science. *BMC Bioinformatics* 12 <https://doi.org/10.1186/1471-2105-12-s15-s2>
- Coronato-Ribeiro A, Pinto-da-Rocha R, Rheims CA (2013) A new species of *Imeri* (Opiliones: Stygnidae: Heterostygninae) from the Brazilian Amazon. *Zoologia (Curitiba)* 30 (3): 329-332. <https://doi.org/10.1590/s1984-46702013000300011>
- da Costa Prudente AL, Ramos L, Silva T, Sarmiento J, Dourado A, Silva F, Almeida P, Santos C, Sousa M (2019) Dataset from the Snakes (Serpentes, Reptiles) collection of the Museu Paraense Emílio Goeldi, Pará, Brazil. *Biodiversity Data Journal* 7 <https://doi.org/10.3897/bdj.7.e34013>
- Dias D, Baringo Fonseca C, Correa L, Soto N, Portela A, Juarez K, Tumolo Neto RJ, Ferro M, Gonçalves J, Junior J (2017) Repatriation Data: More than two million species occurrence records added to the Brazilian Biodiversity Information Facility Repository (SiBBR). *Biodiversity Data Journal* 5 <https://doi.org/10.3897/bdj.5.e12012>
- Feitosa N, Moss D, Ruiz G, Bonaldo A (2017) Twenty-seven new species of the goblin spider genus *Neoxyphinus* Birabén, 1953 (Araneae: Oonopidae) from Brazil. *Zootaxa* 4259 (1): 1-107. <https://doi.org/10.11646/zootaxa.4259.1.1>
- Jim RL, Soares HE (1991) Novo gênero e espécie de Prostyginae do Brasil (Opiliones, Gonyleptidae). *Revista Brasileira de Entomologia* 35 (4): 799-802.
- Kury AB, Pinto-da-Rocha R (2002) Opiliones. In: Adis JA (Ed.) *Amazonian Arachnida and Diplopoda – Keys for the identification to classes, orders, families, some genera, and lists of known species*. Pensoft Publishers, Sofia-Moscow, 345–362 pp.
- Kury AB (2019) Opiliones in Catálogo Taxonômico da Fauna do Brasil. PNUD. <http://fauna.jbrj.gov.br/fauna/faunadobrasil/98744>. Accessed on: 2019-11-23.
- Lança L (2011) Padrões de distribuição espacial de Opilões (Arachnida: Opiliones) em uma área de floresta de terra firme na Amazônia Central. Universidade Federal do Amazonas, Manaus. URL: <http://tede.ufam.edu.br/handle/tede/5450>

- Machado A, Brescovit A, Mielke O, Casagrande M, Silveira F, Ohlweiler F, Zeppelini D, de Maria M, Wieloch A (2008) Panorama Geral dos Invertebrados Terrestres Ameaçados de Extinção. Invertebrados Terrestres- Livro Vermelho da Fauna Brasileira Ameaçada de Extinção. Ministério do Meio Ambiente, Brasília. URL: http://www.mma.gov.br/estruturas/179/arquivos/vol_i_invertebrados_terrestres.pdf
- Merino I, Prieto C (2015) Orden Opiliones . Revista IDE@ - SEA (17)1-12. URL: http://sea-entomologia.org/IDE@/revista_17.pdf
- Petrobras (2016) Fatos e Dados. Urucu: completamos 30 anos na Amazônia com gestão responsável. <http://www.petrobras.com.br/fatos-e-dados/urucu-completamos-30-anos-na-amazonia-com-gestao-responsavel.htm>. Accessed on: 2019-5-21.
- Pinto-da-Rocha R (1997) Systematic review of the neotropical family Stygnidae: (Opiliones, Laniatores, Gonyleptoidea). Arquivos de Zoologia 33 (4). <https://doi.org/10.11606/issn.2176-7793.v33i4p163-342>
- Pinto-da-Rocha R (1999) Opiliones. In: Brandão CR, Cancellato EM (Eds) Invertebrados terrestres. Biodiversidade do Estado de São Paulo. Síntese do conhecimento ao final do século XX. 5. 35-44. FAPESP, São Paulo.
- Pinto-da-Rocha R, Bonaldo AB (2006) A structured inventory of harvestmen (Arachnida, Opiliones) at Juruti river plateau, State of Pará, Brazil. Revista Ibérica de Aracnología 13: 155-162.
- Pinto-da-Rocha R, Carvalho L (2009) A new species of *Sickesia* (Laniatores: Stygnidae: Opiliones) and new records for the State of Piauí, Brazil. Zoologia (Curitiba) 26 (2): 337-342. <https://doi.org/10.1590/s1984-46702009005000001>
- Pinto-da-Rocha R, Bonaldo A (2011) Species relationships in the Neotropical genus *Phareicranaus* Roewer 1913 (Opiliones: Cranaidae): two new species and new data from Penial morphology. Zootaxa 3135 (1). <https://doi.org/10.11646/zootaxa.3135.1.1>
- Pinto-da-Rocha R, Tourinho AL (2012) Two new genera, ten new species and new records of Amazonian Stygnidae Simon, 1879 (Opiliones: Laniatores). Zootaxa 3340 (1). <https://doi.org/10.11646/zootaxa.3340.1.1>
- Sanjad N, Oren DC, Silva Junior JdSe, Hoogmoed MS, Higuchi H (2012) Documentos para a história do mais antigo jardim zoológico do Brasil: o parque zoobotânico do Museu Goeldi. Boletim do Museu Paraense Emílio Goeldi. Ciências Humanas 7 (1): 197-258. <https://doi.org/10.1590/s1981-81222012000100013>
- Silva TMd, Santos JCd, Ferreira VAV, Cruz Ramos LAd, Wosiacki WB, Sousa MPAd (2017) Data from the ichthyological collection of the Museu Paraense Emílio Goeldi. ZooKeys 687: 89-99. <https://doi.org/10.3897/zookeys.687.11233>
- Soler C (2009) A cidade de Coari/AM e os reflexos da exploração de petróleo e gás natural pela Petrobras. Papers do NAEA 253: 3-25.
- Specify (2019) Specify Software Project. Biodiversity Institute, University of Kansas, 1345 Jayhawk Blvd. Lawrence, KS USA 66045. <http://www.specifysoftware.org>. Accessed on: 2019-8-24.
- Tourinho AL, Benchimol M, Porto W, Peres C, Storck-Tonon D (2019) Marked compositional changes in harvestmen assemblages in Amazonian forest islands induced by a mega dam. bioRxiv <https://doi.org/10.1101/542969>
- Wieczorek J, Bloom D, Guralnick R, Blum S, Döring M, Giovanni R, Robertson T, Vieglais D (2012) Darwin Core: An evolving community-developed biodiversity data standard. PLoS ONE 7 (1). <https://doi.org/10.1371/journal.pone.0029715>